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REVIEWS

Early Devonic History of New York and Eastern North America. By JOHN M. CLARKE. New York State Museum, Memoir 9, 1908.

Our knowledge of the Paleozoic faunal history of North America is derived largely from the faunas of the interior epicontinental seas which were spread out upon the continent from time to time, sometimes as great tongue-like embayments, and again as great sheet-like expansions which covered large areas of the continental surface. These shallow epicontinental seas teemed with life and the sediments deposited in them are frequently abundantly fossiliferous. The various elements in these faunas usually give evidence of being immigrants, and the originating tracts in which they were evolved are believed usually to have been in shallow areas on the borders of the oceanic basins. In these border regions having more direct communication with the permanent oceanic basins, the physical conditions were doubtless more nearly continuous than in the more or less transient interior epicontinental seas, and the life history also was probably less liable to abrupt changes. At the present time the Paleozoic rocks of most of the border region of the continent are deeply buried beneath the sea or beneath younger strata, the most notable exception to this condition being found in the great eastern angle of the continent which includes the maritime provinces of Canada. Because of their peculiar relations to the faunas of the interior, any contribution to our knowledge of the ancient faunas of these maritime provinces is received with especial favor. A most notable contribution to the paleontology of this region is a memoir on the *Early Devonic History of New York and Eastern North America*, by the Director of Science of the New York Education Department, which is devoted to a discussion of the lower and middle Devonian faunas of the Gaspè region.

Before entering upon a description of the faunas to be considered, Dr. Clarke has sketched the geology of the region which was first worked out by Sir William E. Logan many years ago. A glowing tribute is rendered this great pioneer in the investigation of Canadian geology, who "sought and found the key to the geologic structure of the country; and so conclusively and with such admirable finish was the work of this master hand accomplished that in all the years since elapsed, from 1844 and 1845, little has been added to, and naught subtracted from his achievements."

The Gaspè peninsula is the northeastern extremity of the Appalachian mountain system, and the geologic structure consists of a series of parallel folds similar to those so well known farther to the southwest, and formed by the same great earth disturbances. The Devonian rocks with whose faunas the memoir is concerned lie unconformably upon older Paleozoic formations. They include the Gaspè limestones and sandstones of Logan. The Gaspè limestone attains a thickness of 2,010 feet and is frequently highly fossiliferous. Three divisions are recognized, the St. Alban limestone below, followed by the Bon Ami limestone, and this again followed by the Grand Grève limestone. The Gaspè sandstones, according to Logan's estimates, attain the enormous thickness of 7,000 feet, but this estimate may be too large by reason of the repetition of some beds by faulting.

From the St. Alban beds a fauna of 51 species is described "of which fully one-half occur in the typical Helderbergian faunas (Coeymans and New Scotland) to the southwest." The fauna of the Bon Ami limestone is small and of much less importance, but the Grand Grève limestone has furnished a fauna of about 150 recorded species. This fauna

> has a less proportion of community of species with the Helderbergian but still a substantial number of species (21 identities and 14 close affines). With the Oriskany there is a larger community of species (39 identities and 13 affines) and so commanding is this percentage and the composition of the congeries itself, consisting as it does of the most typical species of the Oriskany, that it compels this inference: The development of the Oriskany fauna was synchronous with the prevalence of the Helderbergian fauna in this region and the differentiation of the two faunal elements, which we commonly recognize in the Appalachian regions as Helderberg and Oriskany, was subsequent in date to the development of the combined faunas together in Gaspè. Thus again we have evidence that the Gaspè basin was a center of dispersion of these two faunas and that the direction of this dispersion so far as the facts now indicate was still toward the southwest.

The marine fauna of the enormously thick Gaspè sandstone is of but limited extent, and occurs in a comparatively thin horizon of calcareous sandstones which probably lies near the base of the entire series. This great accumulation of arenaceous sediment seems to have been deposited in a great costal lagoon into which terrigenous sediments were rapidly swept. The stratum of marine sediments probably represents overwash of the outside waters in time of stress, bringing in the marine organisms which are now found as fossils. Only about fifty species are recorded in this fauna of which "one-seventh to one-sixth are survivors of the Oriskany element in the Grand Grève limestones. With the Hamilton faunas from the calcareous shales of the Skaneateles, Moscow, and Ludlowville formations of New York, this Gaspè sandstone fauna presents a predominant agreement, having sixteen identities and six affines, or approximately 50 per cent. of the fauna." The presence of this Hamilton element in the fauna is indicative, according to Dr. Clarke, of an invasion of the latter fauna from the west, while the earlier Helderberg-Oriskany fauna still occupied the sea in the Gaspè region. An alternative interpretation, the invasion of the Hamilton fauna from the south along the Atlantic border, should perhaps be considered. The Onondaga fauna is not differentiated in the Gaspè region, it being one of the undifferentiated elements in the Grand Grève fauna.

The evidence is thus fairly cumulative that the Gaspè basin was an area of rapid evolution during the early Devonic and a center of dispersion from which the lines of immigration departed westward. We cannot now say that they did not also lead thence eastward. In a later Devonic stage this basin was the recipient of migrants from the west. The course of migration into and out of the interior Appalachian waters was along a seaway which cannot yet be traced step by step, but evidently parallel to the Appalachian folds. There seems now a fair presumption of a continuous connection between the Gaspè basin and the east by way of the Connecticut trough into eastern New York. The tangible evidence of this connection will be set forth more fully hereafter. The Gaspè Eodevonic basin extended from the Canadian Archean shield at the north to the limit of the Dalhousie beds on the south and contracted in the middle Devonic. Apparently there was no free and open connection between it and the parallel contemporaneous embayments at the south in which the Chapman and Moose River sandstones of Maine were set down.

The faunas described in this Memoir are illustrated by 48 finely executed lithographed plates which are fully up to the standard so long established and maintained by the State of New York in her paleontologic publications. Not the least attractive feature of the book is the frontispiece, a reproduction in color of the painting by Frederick James of that most striking landmark of the Gaspè coast, Percé Rock.

S. W.

Textbook of Petrology. By F. H. HATCH. New York: Macmillan.

This book, which is a fifth edition, revised and rewritten, contains a summary of the modern theories of petrogenesis, a description of the rock-forming minerals, and a synopsis of the chief types of igneous rocks and their distribution as illustrated by the British Isles. The work is concise and somewhat comprehensive and may serve very well for an introduction to the study of igneous rocks, with the aid of the microscope. Part I treats